# Letter from Mauro, Cameron & Lewis to Alexander Graham Bell, June 1, 1903

PHILIP MAURO. LAW OFFICES CABLE ADDRESS: OF S.T. CAMERON. "MAURO—WASHINGTON." MAURO, CAMERON & LEWIS, "PHIMAURO—NEWYORK." REEVE LEWIS. (LIEBERS STANDARD CODE.) C.A. MASSIE. Patents and Patent Causes, TELEPHONE: WASHINGTON, EAST 874. 620 F STREET, WASHINGTON, D. C. NEW YORK, 3298 FRANKLIN. (277 BROADWAY, NEW YORK.) WASHINGTON, June 1, 1903. Alexander Graham Bell, Esq., Dear Mr. Bell:

We enclose carbon copy of page 3 of the triangular case , re-written to omit the matter which you crossed out with your pen at the time of signing the papers.

The applications will be filed today.

Yours very truly, Enc. Dic.L-K. Mauro, Cameron, Lewis

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It has heretofore been proposed to construct a kite or aerodrome composed of two such triangular cells, separated by an open space as in the Hargrave box-kite.

This form of structure is subject to the law above referred to, namely, that an increase of dimensions increases the ratio of weight to surface.

I have found, however, that advantageous results may be obtained by utilizing the triangular cell as a unit or element, and building up structures of large size by combining a number of these units or elements.

Triangular cells are specially adapted for combination into a compound structure in which the aeroplane surfaces do not interfere with each other. Where the edges of two or three

of the elements coincide a single bar or stick will suffice, thus dispensing with the weight of one or two bars or sticks.

In the accompanying drawings, which form part of this specification,

Fig. 1 is a diagram representing an and view of a compound structure composed of triangular cells;

Fig. 2 is a similar view illustrating the omission of the duplicate bars or sticks.

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Aerial Vehicle hr. Beur File Crb

This invention has reference more particularly to the construction of aerial vehicles, and is based upon experiments conducted with kite structures.

Prior to this invention, and largely through the investigations of Laurence Hargrave, the advantages of the cellular box-kite have been made widely known. Although multicellular kites have been constructed upon the Hargrave principle, it has not been observed or pointed out that they possess any substantial advantage over a kite composed of two cells only.

The typical Hargrave kite is composed of two rectangular cells separated by a considerable space, and connected together by a light framework, the cells being disposed in the same horizontal plane. A limit to the lifting power of such kites is quickly reached, since mere enlargement of the dimensions of the parts does not proportionately increase the lifting power. On the contrary, such enlargement increases the ratio of weight to surface exposed to the action of the wind, inasmuch as weight increases as the cube of the dimensions, while the surface increases only as the square of the dimensions.

Furthermore, the rectangular cell is structurally weak and easily collapsed or distorted, giving rise to the necessity for internal bracing. This bracing adds to the dead loads, and

(owing to the shape of the cell) is necessarily so disposed as to increase the resistance of the wind.

These objections have been partly overcome by resorting to a triangular cell, that is to say, a cell of penta gonal hedral form triangular in cross-section, which is self-braced in the direction of its plane.

In such a cell each oblique plane may be regarded as the resultant and equivalent of its horizontal and vertical components, i.e., as presenting a supporting (horizontal) surface and a steadying (vertical) surface.

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This form of structure is subject to the law above referred to, namely that an increase of dimensions increases the ratio of weight to surface.

I have found, however, that advantageous results may be obtained by utilizing the triangular cell as a unit or element, and building up structures of large size by combining a number of these units or elements.

Triangular cells are specially adapted for combination into a compound structure into a compound structure in which the aeroplane surfaces do not interfere with each other. In compound structures composed of a connected group of such cells, the ratio of weight to surface is not increased with the enlargement of the structure, but on the contrary may be diminished. This result is obtained because Where the edges of two or three of the elements coincide a single rod bar or stick will suffice, thus dispensing with the weight of one or two rods bars or sticks. Upon this mode of construction, therefore, the ratio of weight to surface diminishes with every increase in the dimensions of the kite; and the

larger structures have less weight in proportion to their surfaces than the elements of which they are composed.

In the accompanying drawings, which form part of this specification,

Fig. 1 is a diagram representing an end view of a compound structure composed of triangular cells;

Fig. 2 is a similar view illustrating the omission of the duplicate rods bars or sticks.

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Figs. 3 and 4 are similar diagrams illustrating a structure of hexagonal outline; and

Fig. 5 is a perspective view illustrating the embodiment of the invention in a kite of hexagonal form.

In the forms illustrated by the drawings, and in various other structured forms which may be compounded of triangular cells, the latter are connected at their corners so that two or more of the longitudinal rods coincide. Thus, in Fig. 1 is illustrated a compound structure composed of three triangular elements, a, b, c. It is obvious that where two sticks or rods bars come together, as at 6, 7 and 8, these may be replaced by a single stick or rod as at 6, 7 and 8 of Fig. 2.

In Figs. 3 and 4 I have shown the three complete triangular cells connected together in such manner as to form, with the addition of three plane surfaces, d, e, f, a hexagonal outline. The three coinciding rods bars or sticks at the center, 9, in Fig. 3, are replaced by a single rod bar or stick in Fig. 4.

Fig. 5 shows in perspective (the structure standing on end) a kite of hexagonal form composed of winged cells or elements triangular in cross-section. This compound kite is composed of two hexagonal cells A and B, separated by a space C, the interspace being an important feature of kites constructed on this principle. Obviously the principle may be

extended in building up kites composed of a greater number of compound cells separated by intervening spaces as shown in the drawing.

Experiment has shown that kites constructed as illustrated in Fig. 5 possess remarkable buoyancy and great steadiness of flight.

In carrying out the invention it will be obvious that the triangular elements can be combined into structures 5 of various outline, those illustrated and described being given merely by way of example.

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Having now fully described my said invention, what I claim is:

1. A compound cellular serial vehicle, composed of pentahedral elements triangular in cross-section connected at their corners.

2. An aerial vehicle composed of elements triangular in cross-section connected at their corners or edges, and having a single bar or stick at the meeting edge of two elements.

3. An aerial vehicle comprising elements triangular in cross-section, combined to form a structure of hexagonal outline, and provided with covered surfaces.